

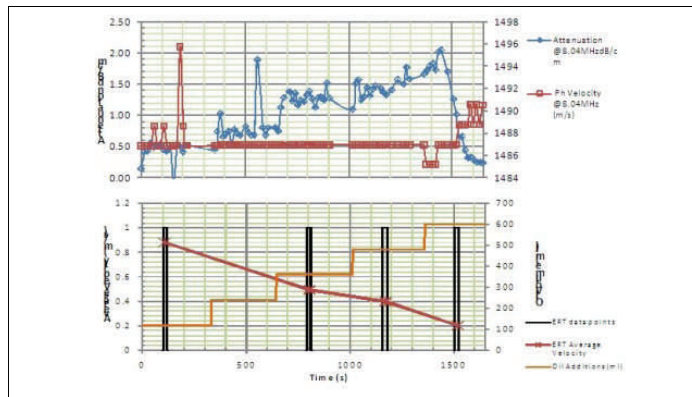


Combined Ultrasonic Spectroscopy and Electrical impedance Tomography of a Sunflower Oil Emulsion

Emulsions are liquid-liquid colloid systems whose properties and appearance are a function of the size of the dispersed phase (droplets). The characteristics of an emulsion are difficult to analyse due to the link between droplet size, stability and volume concentration. Ultrasound spectroscopy is able to characterise emulsions in line at the working concentration hence avoiding dilution with the resultant difficulties this presents in changing the emulsion's properties.

ITS Rheopipe technology combines USS and EIT technology to provide spatial and temporal sensing with microstructural characterisation to understand physical property and flow information of complex materials and processes simultaneously.

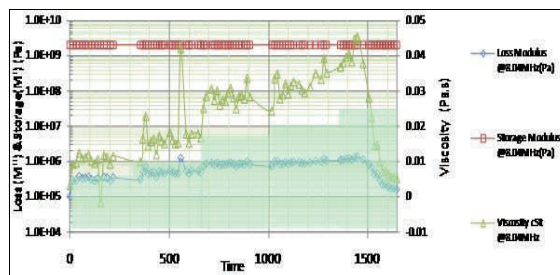
A sunflower oil/water emulsion was produced using the shear forces generated in a rig through additions of sunflower oil to 2.4litres of water circulating in a flow loop. The sunflower oil was added in 120ml quantities at approximately 300 second intervals and the process simultaneously monitored using the ERT and USS sensors.



Process parameters of sunflower oil/water emulsion addition experiment showing the increase in attenuation and the decrease in flow velocity

The results show:

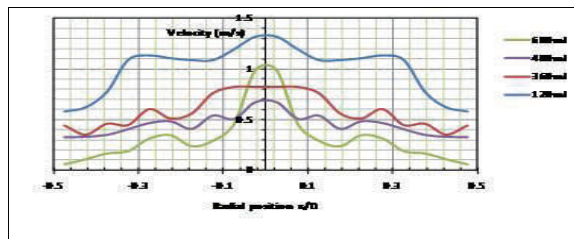
- decrease in flow velocity as measured by ERT
- incremental increases in the attenuation with each addition of oil until the 600 ml addition when the attenuation then decreased.
- increase in the viscosity with each oil volume fraction increase, measured through USS.





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The results are predictable for the initial 5 additions, but in the 6th addition the attenuation initially increases then very rapidly decreases. The decrease in attenuation cannot be explained by changes in the microstructure. In order to explain this phenomenon at the 600ml addition, the flow profile information measurement by the ERT system was examined further.



Flow profile of sunflower oil/water emulsion vs. % Oil

The flow profile in Figure 3 shows that the flow profile is relatively uniform across the cross-section of the pipe for the 120ml, 360ml, and 480ml additions. However at the 600ml addition the flow profile changes significantly and the flow becomes differentiated between a fast core region and a much slower wall flow.

The in-situ characterisation of a sunflower water emulsification process demonstrated that changes in the spectroscopy data could be interpreted only in conjunction with the understanding of the spatial distribution of the material.

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